CHAPTER 14

Communication Devices

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NOTE to REVIEWERS: This is a very early draft version, and no effort has been made to reconcile changes in cross references to other chapters in the guide. Please look for comments such as this in the draft, which encourage your feedback on specific issues.

Please submit comments using the form on http://www.pcdesguide.org or by sending e-mail to comments@pcdesguide.org.

IMPORTANT: The requirements defined in this guide provide guidelines for designing PC systems that will result in an optimal user experience with typical Windows-based applications running under either the Microsoft Windows 98 "Millennium" or later or Windows 2000 Professional or later operating systems. These design guidelines are not the basic system requirements for running any version of Windows operating systems.

Contents

Network Communications

This section presents requirements and recommendations for network adapters and related technologies.

Network communications requirements are based on Network Driver Interface Specification (NDIS) 5.0, which defines the networking requirements, services, terminology, and architecture for Windows 98 and Windows 2000 operating systems. For background information about NDIS 5.0, see the web site at http://www.microsoft.com/hwdev/network/.

Note: References to adapters, network interfaces, and so on in this chapter should be taken to apply to add-on network adapter cards, network implementations on the system board, and external network interfaces equally and without preference for any of these types of implementation, unless otherwise noted.

~~Notice also that, as for all PC 2001 requirements, if it is planned that a specific recommended feature will become a requirement in future versions of these guidelines, it is specifically noted in the text.~~

System Guidelines for Network Communications

This section summarizes the network communications features required for PC 2001 systems.

[20.1] [REDUNDANT] PC system includes network adapter

Note to Reviewers: See the related requirement in the PC 2001 Core System Guidelines

~~**[20.2] [DELETE] PC system includes internal or external ISDN device**~~

~~**[20.3] [DELETE] PC system includes cable modem**~~

~~**[20.4] [DELETE] PC system includes ATM adapter**~~

~~**[20.5] [DELETE] PC system includes ADSL adapter**~~

~~**[20.6] [DELETE] PC system includes satellite or broadcast receiver with NDIS driver**~~

Network Adapter Guidelines

This section defines basic hardware feature requirements for network adapters. Many of these requirements also apply to other network communications devices such as ISDN, cable modem, and ADSL. The applicable requirements for each device category are listed in the related sections later in this chapter.

[20.7] Network adapter uses NDIS 5.0 miniport driver

The network adapter driver must be based on and comply with NDIS 5.0 in order to take advantage of new operating system capabilities. The driver must follow the NDIS miniport driver model defined in the Windows 2000 Device Driver Kit (DDK).

Important: The development of full MAC drivers is no longer supported. Support for full MAC drivers in the operating system will be removed in future versions of Microsoft Windows family of operating systems.

If the network device is for connection-oriented media, such as ATM, ISDN, frame relay, or X.25, it must have a connection-oriented miniport driver that follows the connection-oriented model defined for NDIS 5.0 in the Windows 2000 DDK. Also, for connection-oriented media, there needs to be an NDIS 5.0 call manager driver as defined in the DDK.

In some cases, such as ATM, the call manager driver is included in the operating system. Consequently, for an ATM adapter, the vendor needs to provide only an NDIS 5.0 connection-oriented miniport driver. For connection-oriented media such as ISDN or X.25, the vendor must provide a call manager driver with the hardware, because the call manager is not included in the operating system. Call manager support can be integrated in the connection-oriented miniport driver or implemented as a separate NDIS 5.0 call manager driver. Documentation for both integrated and separated call managers is included in the Windows 2000 DDK.

An intermediate NDIS 5.0 miniport driver is required for network adapters that connect to the PC using IEEE 1394 or USB buses. This driver exposes its media type to NDIS at its upper edge, and it interfaces with the appropriate bus driver (IEEE 1394 or USB) at its lower edge.

[20.8] Intermediate NDIS 5.0 miniport driver is deserialized

NDIS 5.0 introduces support for deserialized miniports. This enables performance improvements and scalability on Windows 2000 multiprocessor systems.

For serialized miniports, NDIS simplifies the driver development by implementing the lock and queue management on behalf of the minport driver. When these drivers are called, NDIS is always called before the miniport driver is entered, which enables NDIS to maintain the lock states and manage the queues of serialized miniport drivers.

This is not always the case with intermediate minport drivers, where the driver can be called directly by another driver outside NDIS, such as the USB bus driver. Therefore, intermediate miniport drivers should be written as deserialized drivers implementing the lock and queue management in the driver.

[20.9] Full-duplex adapter automatically detects and switches to full duplex mode

If both the network adapter and switch port in a link pair support full duplex and there exists a standard way for each to detect and negotiate the duplex mode, the network adapter must negotiate full-duplex mode operation by default. Half-duplex mode can be used if that is the only mode supported by one or both link partners, or it can be manually configured if warranted by special conditions. The goal is to configure this setting automatically without end-user intervention.

[20.10] Adapter automatically senses presence of functional network connection

Where the network allows it, the network adapter must be capable of dynamically determining whether it is functionally connected to a link partner such as a hub, switch, or router. The device must indicate the link state in the following cases:

?? At boot time

?? After returning to D0 power state

?? When the link state changes while in the D0 power state (no time limit is specified for the required detection or status indication)

If the adapter is on an expansion card that is not used as a boot device, ~~then~~ the device drivers can determine the presence of the functional link. If the adapter is not functionally connected to a link partner, the miniport driver must provide appropriate NDIS status indication using support for cable sense in NDIS 5.0.

For information about NDIS status codes and indication mechanisms, see the Windows 2000 DDK.

[20.11] Adapter automatically senses transceiver type

Network adapters that support multiple transceivers must be capable of automatically detecting which transceiver type is connected to the network unless detection is not possible with the network media available. The network adapter then must automatically drive the correct connection. In all cases, the user must not be required to set jumpers or manually enter information to inform the operating system of the transceiver type.

[20.12] Adapter can transmit packets from buffers aligned on any boundary

Buffer alignment refers to whether a buffer begins on an odd-byte, word, double word, or other boundary. Adapters must be able to transmit packets, any of whose fragments are on an odd-byte boundary.

For performance reasons, ~~it is recommended that~~ packets should be received into contiguous buffers on a double word boundary.

[20.13] Adapter communicates with driver across any bridge

If the adapter uses a bridge, all communications must be free of errors across any bridge, such as a PCI bridge adapter.

[20.14] Adapter supports filtering for at least 32 multicast addresses

This requirement applies to networking technologies such as Ethernet, that support multicast. This requirement does not apply to technologies such as Token Ring, which distributes Internet Protocol (IP) multicast traffic using the functional address as specified in RFC 1469.

This capability ~~is needed to support~~supports push technology applications such as Microsoft NetShow™ server, Active Desktop™ interface, and Internet Explorer 4.0 or later version. The minimum required capability is for filtering 32 multicast addresses, also known as channels.

[20.15] Adapter and driver support promiscuous mode

Promiscuous mode ensures that the adapter can be used with Microsoft Network Monitor Agent. This requirement applies only to LAN (non-switched) media.

Notice that, by default, promiscuous mode is not turned on. Enabling promiscuous mode should be possible only by using the Microsoft Network Monitor Agent or another similar administrative application.

[20.16] Adapter is compatible with remote new system setup capabilities if used as a boot device

On a system that uses a network adapter to support installation of the operating system, the network adapter must be compatible with remote new system setup capabilities as defined in the *Network PC System Design Guidelines, Version 1.0b*.

A Desktop PC system must have a network adapter that meets this requirement and the necessary system BIOS capabilities to use the adapter as a boot device, as defined in requirement 3.5, “BIOS meets PC 2001 requirements for OnNow support.”

[20.17] PCI network adapters are bus masters

To improve the system performance by offloading the processor load, PCI network adapters must be bus masters.

[20.18] Device Bay-type network adapter meets PC 2001 requirements

Any network communications device designed as a Device Bay peripheral must interface with USB, IEEE 1394, or both, and must support relevant USB device class specifications. All Device Bay peripherals must meet the requirements defined in *Device Bay Interface Specification, Version 1.0.*

[20.19] If Implemented, USB or IEEE 1394 device meets specifications for network communications devices

Devices must meet requirements in USB 1.1 or later and IEEE1394.a or later.

~~USB network communications device vendors should participate in the USB Device Working Group's effort to define networking extensions to the USB Class Definitions for Communications Devices. Vendors also should implement their hardware to this specification when it is released.~~

Vendors are also encouraged to participate in the definition and implementation of ~~similar~~USB and IEEE 1394 efforts.

[20.20] Network adapter and driver supports priority for IEEE 802-style networks

Windows Quality of Service (QoS) components provide link layer priority information to NDIS 5.0 miniport drivers in each transmitted packet's NDIS_PER_PACKET_INFO structure. ~~Priority values are derived by mapping IETF Integrated Services (intserv) service typed to IEEE 802.1p priority values, referred to as the "user priority" object in the draft available on theweb at http://search.ietf.org/internet-drafts/draft-ietf-issll-is802-svc-mapping-01.txt, which is likely to be superceded by later draft or final specification.~~ The intserv service type used for the mapping is determined by QoS-aware applications, or on behalf of the application, by QoS-aware operating system components. If implemented, link layer priority information must adhere to IEEE 802.lp priority values.

IEEE 802.1p/q-capable Ethernet drivers are expected to use the priority level indicated in the NDIS_PER_PACKET_INFO structure to generate the responding field in the IEEE 802.1p/q MAC headers of transmitted packets. Similarly, these drivers are expected to extract the appropriate information from the MAC headers of received packets and to copy the priority to the NDIS_PER_PACKET_INFO structure before indicating the packet to higher protocol layers.

Notice that any link layer driver has the ability to interpret the priority information in the NDIS_PER_PACKET_INFO structure and use it as appropriate for the particular media.

For more information, see the Windows 2000 DDK and "QoS: Assigning Priority in IEEE 802-style Networks," available on the web at http://www.microsoft.com/hwdev/devdes/qos.htm.

ISDN Guidelines

This section summarizes the design features for ISDN devices.

In this section, "internal ISDN device" refers to the ISDN terminal adapter, which exposes raw access to its B channels using NDIS miniports. Alternatively,

NDIS miniports could ~~also~~ be attached to the PC using WDM-supported bus classes such as USB or IEEE 1394, which would physically be an external device.

"ISDN modem" refers to an ISDN device that exposes itself as a modem controlled by the AT command set. To the operating system~~s~~, these devices look like modems and can be used as modems, so long as the hardware manufacturer provides the following:

?? A modem INF file for installing the device and for telling the Unimodem which commands to use to control the ISDN device.

?? The ability to interpret the standard modem AT command in the ISDN device itself or in a serial port driver. For more information, see the TIA-602 specification, a subset of ITU V.250.

This section defines general requirements for ISDN and specific requirements for ISDN terminal adapters. For information about the requirements for ISDN modems, see Chapter 19, "Modems."

~~ISDN is recommended, but not required, for high-speed connections. If ISDN is implemented in a PC 2001 system, it must meet the requirements defined in this chapter. For Plug and Play, power management, and driver support requirements, see "PC 2001 Design for Network Communications" later in this chapter.~~

[20.21] Internal ISDN device meets PC 2001 network adapter requirements

The ISDN device driver and its INF file must be based on NDIS 5.0 to ensure user-friendly installation and operation of the ISDN adapter.

The following requirements must be met, as defined in "System Requirements for Network Communications" earlier in this chapter:

?? 20.7, "Adapter uses NDIS 5.0 miniport driver, with call manager support" for connection-oriented media

?? 20.10, "Adapter automatically senses presence of functional network connection"

?? 20.12, "Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send"

?? 20.13, "Adapter communicates with driver across any bridge"

?? 20.18, "Device Bay-type network adapter meets PC 2001 requirements"

?? 20.19, "If implemented, USB or IEEE 1394 device meets specifications for network communications devices"

[20.22] Internal ISDN device supports synchronous HDLC framing

High-level data link control (HDLC) framing is a standard for sending synchronous data. Other framing methods are allowed if the miniport driver provides simple HDLC-framed, synchronous Point-to-Point Protocol (PPP) packets to NDIS.

[20.23] NDIS interface and driver support raw unframed synchronous B channel I/O

The internal ISDN device and the driver must support raw, unframed (non-HDLC) synchronous B channel I/O at 64 Kbps per B channel, with each B channel individually accessible. This ~~will enable~~support enables H.320 as well as voice calls over ISDN without audio breakup.

For these raw interfaces, the direct path to each B channel must support synchronous transmission and reception of H.221 frames, which are of 20 ms duration. ~~To achieve this without additional latency to H.221, there must be support for~~ overlapped I/O buffersat intervals of less than or equal to 20 ms ~~in each direction. As~~ Since underruns or overruns cause degraded audio, hardware buffering must be adequate to prevent B channel underruns and overruns. For Windows 98 and Windows 2000, 20 ms is adequate.

~~This~~ Underrun and overrun prevention can be achieved by making buffering software configurable with adequate range to handle foreseeable real-world conditions. The miniport driver should make I/O completion callbacks to NDIS for each I/O buffer as soon as the I/O for that buffer is complete; it should not coalesce or delay callbacks.

[20.24] ISDN driver supports unattended installation, with limitations

Configuration of the dependent parameters, such as service profile IDs (SPIDs) and switch-type IDs, must be done through the ISDN Configuration wizard included in the operating system.

~~[20.25] [DELETE] ISDN device with U interface includes built-in NT-1 capability~~

Note to Reviewers: Recommendations are not included in PC 2001

[20.26] ISDN device includes software-selectable terminating resistors

If the ISDN device has an S/T-interface for connecting additional ISDN devices, it must also have software-configurable terminating resistors that can be selected on or off. The default value of the termination is on in North America, but off in all other countries, where phone companies unconditionally provide the termination.

Cable Modem Guidelines

A cable modem connected to a PC is one system component that cable-television operators use to deliver high-speed cable data services to customers.

Cable modem provides two-way services: Data flows downstream from the cable operator's head end and upstream from the customer's PC. At the head end, the cable data system is terminated by the cable modem termination system (CMTS), which terminates the upstream and downstream radio frequency (RF), MAC layer, and possibly Layer 3 protocols from the cable side. CMTS provides the internetwork connection between the cable system and the rest of the network at the head end. CMTS can be implemented on a proprietary hardware platform or a PC platform running Windows 2000 to provide different networking functions such as routing or QoS support, for example, RSVP.

~~Some implementations transmit upstream using narrow-band networks, such as ISDN or analog modem. But as cable companies upgrade their networks, an increasing number of RF return modems, for example, two-way modems, are being deployed. Two-way modems are preferred because they are always connected, perform better, and do not tie up phone lines or require modem banks.~~

The three current cable modem specifications are:

?? Data-Over-Cable Service Interface Specification (DOCSIS), developed by the Multimedia Cable Network System (MCNS) consortium.

?? IEEE 802.14, developed by IEEE.

?? Digital Video Broadcasting/Digital Audio-Visual Council (DVB/DAVIC), developed by DAVIC and DVB and adopted by European Telecommunication Standards Institute (ETSI) and International Telecommunication Union (ITU).

Industry support for DOCSIS is growing rapidly in North America. In present form, its upper layers fully describe IP traffic encapsulated by 802.3/DIX Ethernet framing. ATM is left for future study.

External Ethernet DOCSIS cable modems provide IEEE 802.1d bridging for one or more Customer Premises Equipment. A PC attaches to the cable modems indirectly through its 10BASE-T network adapter. Integrated cable modems attach directly to the PC over buses such as USB, PCI, and IEEE 1394 and they require a vendor-supplied NDIS 5.0 miniport driver. This driver exposes an 802.3/DIX Ethernet adapter interface to the operating system and it interfaces to the cable modem hardware using the appropriate bus (PCI) or bus interface driver, USB or IEEE 1394 at its bottom edge.

In contrast to DOCSIS, both the IEEE 802.14 and the DVB/DAVIC efforts are focused on using ATM, typically implementing an ATM adapter interface and using an NDIS 5.0 ATM miniport driver.

~~**[20.27] [DELETED] Device is implemented as an integrated cable modem**~~

Note to Reviewers: Recommendations are not included in PC 2001

[20.28] Integrated cable modem meets PC 2001 network adapter requirements

For the integrated cable modem, the following requirements must be met as defined in "Network Adapter Requirements" earlier in this chapter:

?? 20.10, "Adapter automatically senses presence of functional network connection"

?? 20.12, "Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send"

?? 20.13, "Adapter communicates with driver across any bridge"

?? 20.17, "PCI network adapters are bus masters"

?? 20.18, "Device Bay-type network adapter meets PC 2001 requirements"

?? 20.19, "If implemented, USB or IEEE 1394 device meets specifications for network communications devices"

For an integrated cable modem exposing an ATM interface, the following requirements must be met as defined in "Network Adapter Requirements" earlier in this chapter:

?? 20.7, "Adapter uses NDIS 5.0 miniport driver" for connection-oriented media

For an integrated cable modem exposing an Ethernet interface, the following requirements must be met as defined in "Network Adapter Requirements" earlier in this chapter:

?? 20.7, "Adapter uses NDIS 5.0 miniport driver"

?? 20.14, "Adapter supports filtering for at least 32 multicast addresses"

?? 20.15, "Adapter and driver support promiscuous mode"

[20.29] Integrated cable modem exposes an ATM or Ethernet interface

An integrated cable modem should expose an ATM or Ethernet interface to the operating system. For the specific requirements if an ATM/cable modem solution is implemented, see "ATA Adapter Requirements" later in this chapter.

ATM Adapter Guidelines

This section summarizes requirements for ATM hardware.

The NDIS 5.0 extensions provide kernel-mode NDIS 5.0 client drivers with direct access to connection-oriented media such as ATM. The new architecture for Windows 98 and Windows 2000 extends native ATM support to Windows

Sockets 2.0 (WinSock), Telephony API (TAPI), and DirectShow-based applications by providing system-level components that map the applicable WinSock, TAPI, and DirectShow APIs to NDIS 5.0, extending direct ATM access to user-mode applications.

If ATM is included in a PC 2001 system or is specifically designed for Windows 98 or Windows 2000, it must meet the requirements defined in this chapter. For basic requirements for Plug and Play, power management, and driver support, see "PC 2001 Design for Network Communications" later in this chapter.

For more information related to these requirements, please refer to "ATM Layer Specification," in *ATM User-Network Interface Specification, Version 3.1*. This specification includes references to other relevant specifications.

[20.30] ATM adapter meets PC 2001 network adapter requirements

The following requirements must be met as defined in "Network Adapter Requirements" earlier in this chapter:

?? 20.7, "Adapter uses NDIS 5.0 miniport driver" for connection-oriented media

?? 20.10, "Adapter automatically senses presence of functional network connection"

?? 20.12, "Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send"

?? 20.13, "Adapter communicates with driver across any bridge"

?? 20.17, "PCI network adapters are bus masters"

?? 20.18, "Device Bay-type network adapter meets PC 2001 requirements" and

?? 20.19, "If implemented, USB or IEEE 1394 device meets specifications for network communications devices"

[20.31] ATM adapter supports a minimum number of simultaneous connections

The Virtual Path Identifier (VPI) and Virtual Channel Identifier (VCI) ranges supported by the adapter affect the maximum number of simultaneous connections supported on a system.

This affects the applicability of the adapter to ATM applications such as LAN emulation, where at least one dedicated VC is created between each pair of communicating ATM hosts.

System type	Simultaneous connections
Client (ATM adapter)	64 or more
Client (Integrated ATM/ADSL adapter)	32 or more

A sample driver is provided in the Windows 2000 DDK to guide developers in properly supporting resources to meet this requirement.

~~**[20.32] [DELETED] ATM adapter supports all service types defined by the ATM Forum**~~

Recommendations are not included in PC 2001

[20.33] ATM adapter supports UBR service type

UBR is used by default for standard ATM services such as LAN Emulation and IP over ATM. In addition, PPP is a widely used model for residential network access, and UBR is used by default for PPP-over-ATM virtual circuits. Therefore, ~~it is required for~~ ATM adapters ~~to~~ must support the UBR service type.

[20.34] ATM adapter supports a minimum number of simultaneously active VBR or CBR connections

Support is required for at least two simultaneously active VBR or CBR connections for basic ATM signaling and management.

Support for at least six VBR/CBR connections is needed for ATM adapters that support multimedia or other traffic that demands QoS.

[20.35] ATM adapter supports traffic shaping

The ATM adapter must support and enforce all the traffic-shaping rules specified for each service type it supports, including CBR, VBR, ABR, and UBR.

This includes enforcement of peak cell rate on UBR virtual circuits, as described in the following requirement.

[20.36] ATM adapter enforces PCR on UBR virtual circuits

ATM adapters can be used to connect the router, remote access, and content servers to the public ATM network. High-speed residential broadband access networks, such as ADSL and cable modem, can enable direct connection, using an ATM virtual circuit, from home or small office computers to these servers.

When the Windows Dial-Up Networking user interface is used to connect from the home ~~or SOHO~~ computer to the remote router or server, a PPP link is established over an ATM virtual circuit, using the UBR service type. When creating the UBR virtual circuit, Windows ~~will~~ requests upstream and downstream line rates, or Peak Cell Rates (PCR), equal to the upstream and downstream line rates provided for the user. Windows uses the ATM Interim Local Management Interface (ILMI) protocol to obtain information such as the user's line rates provided by the public network.

To avoid packet loss and ensure efficient network utilization, it is critical that all ATM adapters, integrated ATM/ADSL adapters, and ATM/cable modem adapters enforce requested PCR on UBR virtual circuits.

Because any ATM adapter might be installed in a server to which clients connect through the public network, this requirement applies to all ATM adapters.

[20.37] ATM adapter and driver support dynamic link speed configuration

When connected to a residential broadband network, ATM adapters must restrict the aggregate transmission rate across all active virtual circuits so that it does not exceed the upstream bandwidth provided by the residential broadband network.

Therefore, all integrated ATM/ADSL adapters and ATM/cable modem adapters must support aggregate shaping of upstream bandwidth, according to the provisioned upstream bandwidth, or the trained bandwith, whichever is lower. Some implementations can support rate adoption and lower-than-provisioned rates might be negotiated because of poor line conditions. In addition, because any 25 Mbps ATM adapter might be used to connect to an ADSL network by way of an external ADSL modem, it is required that all 25 Mbps ATM adapters support this as well. This support is optional for ATM adapters with line rates higher than 25 Mbps.

The Windows ATM Call Manager uses ILMI to query the public network to determine the maximum line rates provisioned for incoming and outgoing traffic. The Call Manager then uses the OID_GEN_CO_LINK_SPEED NDIS request (in SET mode) to set the line rate for both incoming and outgoing traffic, within which the adapter can shape the aggregate of all ATM traffic.

[20.38] ATM adapter that supports OAM responds to F4 and F5 loopback cells

~~Operation and maintenance (OAM) is needed for diagnostics. This capability is recommended for Client systems.If implemented, it is required that received F4 and F5 loopback OAM cells must be responded to. Support for other layers, F1-F3, is optional.~~

Adapters that receive F4 and F5 loopback OAM (Operation and Maintenance) calls must be responded to on adapters that support OAM. This capability is needed for diagnostics. Support for layers F1-F3 is optional.

~~**[20.39] [DELETED] ATM adapter supports buffer chaining (Tx + Rx)**~~

ADSL Guidelines

This section summarizes requirements for ADSL hardware.

Support is provided in the Windows 98 and Windows 2000 operating systems for ADSL adapters and external ADSL modems, such as those using USB, which provide a faster method for moving data over regular phone lines.

~~Recommended:~~ Manufacturers ~~should~~ are encouraged to participate in developing standards for this technology and review the white paper that was jointly developed by over 30 leading ADSL vendors, *An Interoperable End-to-End*

Broadband Service Architecture over ADSL System, Version 3.0, which discusses end-to-end service interoperability over ATM over ADSL. This paper is available at http://www.microsoft.com/hwdev/devdes/publicnet.htm. The core idea of this white paper (PPP over ATM over ADSL) has been adopted by the ADSL Forum.

~~**[20.40] [DELETED] ADSL device is implemented as an integrated ADSL modem**~~

Note to Reviewers: Recommendations are not included in PC 2001

[20.41] Integrated ADSL modem meets PC 2001 network adapter requirements

~~For t~~The integrated ADSL modem~~, the following requirements~~ must meet the following requirements, ~~be met~~ as defined in "Network Adapter Requirements" earlier in this chapter:

?? 20.10, "Adapter automatically senses presence of functional network connection"

?? 20.12, "Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send"

?? 20.13, "Adapter communicates with driver across any bridge"

?? 20.17, "PCI network adapters are bus masters"

?? 20.18, "Device Bay-type network adapter meets PC 2001 requirements"

?? 20.19, "If implemented, USB or IEEE 1394 device meets specifications for network communications devices"

For the integrated ADSL modem exposing ATM interface, the following requirements must be met as defined in "Network Adapter Requirements" earlier in this chapter.

?? 20.7, "Adapter uses NDIS 5.0 miniport driver" for connection-oriented media

For the integrated ADSL modem exposing Ethernet interface, the following requirements must be met as defined in "Network Adapter Requirements" earlier in this Chapter.

?? 20.7, "Adapter uses NDIS 5.0 miniport driver"

?? 20.14, "Adapter supports filtering for at least 32 multicast addresses"

?? 20.15, "Adapter and driver support promiscuous mode"

~~**[20.42] [DELETED] ATM/ADSL solution is implemented for integrated ADSL modems**~~

Note to Reviewers: Recommendations are not included in PC 2001

[20.43] UADSL modem supports DMT line encoding

The ADSL modem should support Discrete Multi-tone (DMT) line encoding, which both the Universal ADSL Working Group (UAWG) and ANSI recognize ~~is recognized~~ as the industry standard for ADSL ~~by ANSI~~ as the T1.413 Issue 2 specification~~, and also by the Universal ADSL Working Group (UWAG).~~ For information, see http://www.uawg.org.

DMT is required for UADSL implementations. The UAWG has adopted DMT specified by T1.413, with modifications being made for it to work in a splitterless environment.

~~**[20.44] [DELETED] ADSL modem supports rate adaptation**~~

Note to Reviewers: Recommendations are not included in PC 2001

IrDA Guidelines for Network Communications

The interface between Infrared Data Association (IrDA) hardware (framers) and the Windows IrDA stack is through NDIS 5.0 miniport drivers that adhere to the conventions defined in *Infrared Extensions to the NDIS Version 4.0 Functional Specification*. The Windows IrDA stack expects that hardware and NDIS drivers deal with framing, transparency, and error detection, as well as supporting media-sense and speed-change commands. Miniport drivers are responsible for discarding incoming frames with bad cyclic redundancy checks. These frames must never be forwarded to the protocol.

Although the IrDA protocol stack in Windows 2000 is different from the one on Windows 98, the Windows 2000 DDK should be used for driver development for both platforms. The Windows 2000 IrDA protocol stack imposes stricter requirements on drivers than the protocol stack on Windows 98.

[20.45] Infrared device meets PC 2001 network adapter requirements

The following requirements must be met as defined in “Network Adapter Requirements” earlier in this chapter:

?? 20.7, “Adapter uses NDIS 5.0 miniport driver”

?? 20.12, “Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send”

?? 20.13, “Adapter communicates with driver across any bridge”

?? 20.17, “PCI network adapters are bus masters”

?? 20.18, “Device Bay-type network adapter meets PC 2001 requirements”

?? 20.19, "If implemented, USB or IEEE 1394 device meets specifications for network communications devices"

[20.46] Infrared device supports both FIR and SIR

All infrared devices must comply with approved IrDA specifications, including support for SIR, FIR, and VFIR data devices.

Note to Reviewers: What are the approved IrDA specs you'd want cited and how completely must one comply with them?

[20.47] IrDA hardware supports unattended driver installation

FIR Plug and Play hardware must report a unique Plug and Play ID that matches the combination of the chip set, transceiver, and any other system-specific parameters, ~~in order~~ for the operating system to find and install the correct INF and the associated driver for the IrDA hardware.

In the best case, the IrDA hardware has only one Plug and Play ID associated INF file and a miniport driver that can autodetect the transceiver type and other system-specific parameters. This combination enables the installation and configuration of the hardware and the driver without user intervention.

In other cases, for example, where the miniport driver cannot autodetect the transceiver type or any other system-specific parameters, a unique Plug and Play ID for each combination of the chip set and the transceiver type must be reported. Also, the vendor must provide for each combination an associated driver and INF file describing the configuration parameters.

Home Networking Guidelines

~~Home networking is a significant new area with different constraints than conventional networking and few products currently on the market. Currently, important applications are sharing Internet access and peripherals, but new applications might develop.~~

~~Because this networking area is so new, it is appropriate that this guide set a standard for the quality of the user experience with as few hard technical standards as possible, allowing time for a marketplace to develop.~~

~~A Desktop PC system must include a modem or other Internet access device. However, in a home with networked PCs, some kind of gateway is desirable to enable simultaneous access to the Internet from multiple clients. Such a gateway can be implemented in PC software or embedded in a non-PC networking solution.~~ In a home with networked PCs, a gateway providing Internet access to multiple clients can be implemented in PC software or embedded in a non-PC networking solution. These gateway functions can include networking services such as DHCP Proxy, NAT Router, and Firewall. All the PCs in this scenario

must have a network adapter for peer-to-peer connectivity for accessing the Internet link provided by the home gateway.

~~Although there is no explicit speed requirement for home networking media, designers should recognize that higher bandwidth supports greater capabilities. For example, to support MPEG-2 playback, 1.5 Mbps is needed; however, a full MPEG-2 video stream requires closer to 10 Mbps.~~

[20.48] If implemented, home networking adapter meets PC 2001 network adapter requirements

The following requirements must be met, as defined in "Network Adapter Requirements" earlier in this chapter:

?? 20.7, "Adapter uses NDIS 5.0 miniport driver"

?? 20.10, "Adapter automatically senses presence of functional network connection"

?? 20.11, "Adapter automatically senses transceiver type"

?? 20.12, "Adapter supports quadword or smaller buffer alignment for receive and byte buffer alignment for send"

?? 20.13, "Adapter communicates with driver across any bridge"

?? 20.18, "Device Bay-type network adapter meets PC 2001 requirements"

?? 20.19, "If implemented, USB or IEEE 1394 device meets specifications for network communications devices"

?? 20.14, "Adapter supports filtering for at least 32 multicast addresses"

?? 20.15, "Adapter and driver support promiscuous mode," for network media that confine network traffic signals within a single home

?? 20.17, "PCI network adapters are bus masters"

~~Home networks will differ from traditional, homogeneous business networks because they are expected to incorporate many types of media and link layer protocols spanning a smaller number of hosts. Even though media types and link layer protocols will be optimized with respect to features such as bandwidth and isochrony, it is important that IP protocols be supported in every case in order to enable traditional PC-to-PC networking.~~

~~The following features are recommended:~~

~~? 20.14, "Adapter supports filtering for at least 32 multicast addresses"~~

~~? 20.15, "Adapter and driver support promiscuous mode," for network media that confine network traffic signals within a single home~~

~~? 20.17, "PCI network adapters are bus masters"~~

~~**[20.49] [DELETED] Home networking uses appropriate media**~~

Note to Reviewers: Recommendations are not included in PC 2001

[20.50] Home networking media supports IP

Any home networking media must support IP, yet not preclude the use of other protocols.

[NEW] If implemented, system that supports Home RF complies with SWAP specification

If a PC 2001 system that implements Home Radio Frequency (Home RF), it must comply with the Shared Wireless Access Protocol (SWAP) Specification, Version 1.1(or later), available at http://www.homerf.org/tech/. This specification is produced by the HomeRF® Working Group.

[NEW] If implemented, system that supports Bluetooth complies with Bluetooth 1.0

If A PC 2001 system that implements Bluetooth technology, it must comply with the Bluetooth Specification, Version 1.0, available from http://www.bluetooth.com/http://www.bluetooth.com/.

PC 2001 Design for Network Communications

This section summarizes requirements related to the PC 2001 design initiatives defined in Part 1 of this guide.

Plug and Play and Bus Design for Network Communications

The items in this section are requirements for Plug and Play capabilities.

[20.51] [REDUNDANT] Each device has a unique Plug and Play device ID

Note to Reviewers: This basic PC 2001 requirement is no longer repeated in every chapter.

[20.52] [REDUNDANT] Dynamic resource configuration is supported for all devices

[20.53] Plug and Play capabilities support multiple adapters

For network communications devices, the Plug and Play IDs and resource support must be sufficient support automatically the addition of multiple network communications devices to the system. This is true both for the same and different types of network communications devices.

[20.54] All resource settings are reported in the user interface

All resource settings must be viewable in the Device Manager and in the adapter properties dialog boxes. All resource settings that can be changed by the user must be changed using the standard Windows user interface, not ~~by way of~~ through the use of INI files or other setting files.

This guideline implies that all device resources must be set and read through the standard interfaces provided by the bus on which the device resides. For PCI devices, this interface is the PCI configuration space. Also, device parameter settings must be stored in the registry.

Power Management for Network Communications

This section summarizes the specific power management requirements for network communications devices.

[20.55] Adapter complies with Network Device Class Power Management Reference Specification

The *Network Device Class Power Management Reference Specification, Version 1.0a*, provides definitions of the OnNow device power states (D0–D3) for network adapters. The specification also covers the device functionality expected in each power state and the possible wake-up event definitions for the class.

Network communications devices that directly attach to the PC over USB, PCI, and IEEE 1394 must comply with this specification.

[20.56] Network device supports wake-up events

This requirement applies specifically to the following network communications devices and their associated NDIS 5.0 miniport drivers:

?? Ethernet and Token Ring network adapters

?? Integrated DOCSIS cable modems

?? Other devices that transfer IEEE 802.3/DIX Ethernet framed packets

Network Device Class Power Management Reference Specification does not yet define wake-up mechanisms for ISDN adapters or any network communications adapter that uses ATM signaling.

The system must be capable of wake-up from a lower power state based on network events that are specified by the local networking software. As a result of this capability, ~~yields the result that~~ any standard Windows network access—such as connections to shared drives and WinSock connections, plus service and management applications—can wake a system from lower power states transparently.

As defined in *Network Device Class Power Management Reference Specification*, a network adapter and its driver must support wake-up on receipt of a network

wake-up frame. Support for wake-up on detection of a change in the network link state or on receipt of a magic packet event is optional. Implementation details are described in the "Network Wake-up Frames" and "Network Wake-up Frame Details" sections of *Network Device Class Power Management Reference Specification, Version 1.0a* and in the Windows 2000 DDK. See also the implementation notes at http://www.microsoft.com/hwdev/devdes/netpm.htm.

The packet patterns that define the wake-up frames are provided to the NDIS 5.0 miniport driver by the operating system. To enable Wake-On-LAN capability for basic networking scenarios, the network adapter must be capable of storing information describing a minimum of three wake-up packet patterns, and it must be able to recognize wake-up packets based on pattern matches anywhere in the first 128 bytes of the packet.

Network adapters should be capable of storing information describing at least five wake-up packet patterns to enable more advanced applications, such as Wake-On-LAN capability on multi-homed systems or on receipt of multicast packets, in addition to the above basic scenarios.

PCI-based network adapters must support the generation of a power management event (PME# assertion) from the D3 cold device state if the physical layer technology is generally capable of operating under the voltage and current constraints of the D3 cold device state. For example, 100baseTX adapters can meet this requirement based on the state of the art available in mid-1998. 1000baseSX or 1000baseLX (gigabit Ethernet using optical fiber media) cannot meet this requirement because of the power required to operate the optical physical layer.

Device Drivers and Installation for Network Communications

This section summarizes requirements for network communications device drivers, in addition to the requirements for using an NDIS 5.0 miniport driver as defined in "System Requirements for Network Communications" earlier in this chapter.

[20.57] [REDUNDANT] Device drivers and installation meet PC 2001 requirements

Note to Reviewers: This basic PC 2001 requirement is no longer repeated in every chapter

[20.58] Driver works correctly with Microsoft network clients and protocols

This requirement includes the 32-bit Microsoft client and NetWare-compatible clients provided with Windows, whether connected to a Windows 2000-based server, a Novell NetWare 3.*x* or 4.*x* server, or a Windows-based peer server. In

all cases, this ~~includes~~requirement applies to connections using Microsoft TCP/IP, IPX/SPX-compatible protocol, and NetBEUI in local area networks and TCP/IP in wide area networks.

[20.59] NDIS miniport driver makes only NDIS library calls or WDM system calls

A miniport driver must make calls only to the NDIS library or the WDM system~~. This results in~~ to provide binary compatibility of the driver between Windows 98 and Windows 2000.

NDIS conformance must be validated over a single network connection and multiple connections. For Windows 2000, ~~this~~conformance must be validated on a multiprocessor system as part of compliance testing.

[20.60] NDIS 5.0 driver uses Windows 2000 INF format

All network components must use the INF format defined in the Windows 2000 DDK.

Note: For Windows 2000, ~~there will be~~ the operating system provides no legacy INF support and no satisfactory upgrade option for OEM components created for an earlier version of Windows.

Voiceband (POTS) Modems

This section covers voiceband or POTS (Plain Old Telephone System) modems.

[19.3] Modem supports V.250 AT command set

Note to Reviewers: Require buffer size control command here.

International Telecommunications Union (ITU) Recommendation V.250 is a superset of the TIA-602 basic AT command set with significant and useful improvements. It includes these new components:

?? A standard format for extending the AT command set, with standard means for the PC to test the range of supported values for each command. This standardization enables adaptive modem installation.

?? Standard extensions for modem ID, port control, modulation control and reporting, error control, and data compression control and reporting. These extensions reduce or eliminate the need for data-modem INF files.

~~Related Recommendation~~V.251, formerly known as Annex A/V.25 *ter*, provides standard commands that enable the PC to use V.25, V.8, and V.8 *bis* call-control features for point-to-point data calls, voice/data/video calls, and voice-to-data transitions.

~~It is not required to implement every AT command, result code, and information text defined in V.250. If a particular function is not implemented in a modem or is~~

~~not controllable by way of the AT command, then the corresponding V.250 AT command need not be implemented.~~

If the AT command for a particular function is implemented, the corresponding V250 AT command must be supported.

However, any modem function controllable by way of the AT command must be controllable by the appropriate V.250 command if one is defined in V.250 for that function. Optionally, the function also can be controlled by a proprietary command. Similarly, any reportable modem event must use the report defined in V.250, if one exists.

The essential V.250 commands are the following:

?? All basic mode commands from TIA-602 (no + prefix)

?? Identification: +GMI, +GMM, +GMR

?? Port control: +IPR, +ICF, +IFC, +ILRR

?? Modulation: +MS, +MR, +MA

?? Error control: +ES, +ER, +EB, +ESR, +ETBM

?? Compression: +DS, +DR

The modem must also be able to generate appropriate V.250 responses enabled by the +ILRR, +MR, +ER, and +DR commands. The standard format allows a future modem installer to adaptively install and use a modem, with minimal need for INF-file minidrivers.

[19.4] Modem supports V.90 (1998) analog modem modulation

ITU-T Recommendation V.90 modulation supports pulse-code modulation (PCM) connections to digitallyconnected central sites, at data rates from 56 Kbps down to 28 Kbps.

V.90 support implies support for V.34, which is used for analog-to-analog connections and for connections to central sites from users whose telephone lines do not support V.90 operation, at speeds from 33.6 Kbps down to 2400 bps.

Mobile PC Note

For mobile PCs, if modem capabilities are integrated in the base platform, ~~then~~ V.34 or higher is required. All other requirements for modems must be met as defined in this chapter.

[19.5] If V.34 SRC is implemented, modem supports Annex A/V.34 (1998) Seamless Rate Change (SRC)

Seamless Rate Change (SRC) procedures defined in new Annex A/V.34 (1998) enhance performance during data mode, because data pump speed changes take place without blocking data flow. SRC is critical for IP-Telephony applications such as H.323/PPP or H.324 over a V.34 data modem. Without SRC, rate changes interrupt voice channels for 10 or more seconds (for retrains) or

approximately 1 second (for rate negotiations). SRC might also allow a faster startup procedure because the data pump can converge quickly on a sub-optimal slower initial speed. An examplemight be to initiate ISP connection negotiations, then change to higher speeds as the pump training is refined.

[19.6] Modem must support V.42 LAPM, V.42 *bis*, and V. 80 Synchronous Access data protocols

The V.42 Link Access Procedure for Modems (LAPM), which provides error control, together with the V.42 *bis* data compression procedures, are particularly well suited to traditional bulk data delivery modem applications.

The Synchronous Access modes defined in Chapter 8 of V.80 allow the data protocols in the modem to be bypassed and allow any arbitrary, non-traditional protocol to be implemented in the host. For example, ~~it allows~~ host-based V.70 Simultaneous Voice/Data or host-based H.324 video telephony systems ~~to~~ can be implemented. Chapter 8 of V.80 requires implementation of both Framed sub-Mode and Transparent sub-Mode.

Because V.42 LAPM is the default mode of operation in most modems, it is commonly used when accessing Internet Service Providers (ISPs). The asynchronous (character-oriented) form of the Point-to-Point Protocol (PPP) runs on top of LAPM.

For enhanced, lower-latency performance for such applications as Internet telephony, V.80 can be used together with the synchronous form of PPP. V.8 *bis* can be used to negotiate the use of V.80. In particular, the AT+ITF command defined in V.80 is useful in reducing the buffering delays in the modem transmitter.

[19.7] Modem supports call control signaling, controlled using V.251 modem commands

To comply with PC 2001 requirements, V.90 and V.34 modems must support ITU Recommendations V.8, V.8 *bis*, and Recommendation V.251.

ITU Recommendation V.8 *bis* provides for the negotiation and selection of call functions between end points, and enables smooth voice-to-modem transitions during a call. V.8 *bis* is required for multimedia modes such as V.61 Analog Simultaneous Voice and Data (ASVD) and V.70 Digital Simultaneous Voice and Data (DSVD). Also, V.8 *bis* is used to negotiate the use of manufacturer-specific modulations and features. V.8 *bis* defines code points for V.42 and V.80 modes of operation. It enhances the basic call function selection embodied in the recommendations for V.25 and V.8.

ITU Recommendation V.251 enables the PC to participate in call control, allowing flexibility and a visual user interface as well as saving modem complexity. At a minimum, the V.251 implementation must:

?? Support V.8 operation that is controlled by Data Circuit Terminating Equipment (DCE) with Data Terminal Equipment (DTE) notification

?? Support DTE-controlled V.8 bis operation

?? Support backward compatibility for media detection with terminals using V.25 signaling, for example, data calling tone and fax calling tone

?? Support backward compatibility for media detection with older modems, for example, V.32 and V.32 bis

?? Provide a means for turning on the V.8 Calling Indicator (CI) signal for originating calls

The *Video-Ready Modem Handbook* specification from Intel Corporation describes an example using V.251 for call control and call function selection. The specification also gives implementation guidance for the use of V.80 in low-latency applications.

To support media detection in future Microsoft Back Office® family of products, ~~it is recommended that~~ OEMs are encouraged to have the V.251 modem implement the <a8a> codepoints for DTE-controlled operations (2, 3, and 4).

[19.8] FAX modem supports 14.4 Kbps (V.17) with Class 1 command set

When a fax modem is implemented, fax capabilities are required. The fax modem must support 14.4 Kbps (V.17) with the Class 1 (TIA-578-A) command set.

~~In addition to the required fax capabilities, the following enhanced capabilities are recommended for fax modems:~~

~~? Class 1.0 (ITU T.31) with +FAR support, which allows the hardware to perform adaptive carrier detection~~

~~? Class 2.0 (ITU T.32 or TIA-592) for rack-mounted server modems~~

~~? Adaptive DATA/FAX call classification based on the Class 2.0 +FAA command or equivalent (for example, +FAE), particularly for rack-mounted server modems~~

~~? V.34 half-duplex (33.6 Kbps) modulation, controlled by Annex B/T.31 procedures~~

Windows includes fax modem support. Windows 2000 and future versions of Microsoft BackOffice family of products will support Class 1.0 and Class 2.0 fax modems and adaptive FAX/DATA call classification. To benefit from this support, modem vendors should extend their modem INF files to support the registry keys for these features, as defined in the Windows Modem Developers Kit (MDK).

[19.9] If delayed and blacklisted number tables are implemented, modem clears its tables when off hook

Note to Reviewers: Is this guideline still an appropriate requirement?

This support is required for modems supporting delayed and blacklisted number tables. The modem must clear its delayed and blacklisted number tables if the associated handset goes off hook.

During certain international Post, Telephone, and Telegraph (PTT) certification processes, modems must support the delayed and blacklisted numbers feature. ~~That means that~~ When the modem fails to connect to a specific number for a certain number of times, the dialed number is stored in an internal list. Subsequent automated dialing operations to this number are either delayed for a time or ~~might be~~ possibly forbidden until some form of manual intervention occurs (blacklisted). The international certification processes specify that clearing these numbers requires manual intervention using an external device~~is required in order to clear these numbers~~.

To reduce customer confusion, Windows provides error messages corresponding to delayed and blacklisted error reports~~in order to reduce customer confusion~~.

[19.10] If TDD support is implemented, modem supports TDD, meeting V.18-1996 with V.250 AT commands

People who are deaf or hard of hearing can use Telephone Device for the Deaf (TDD), also known as Text Telephones, to communicate over phone lines. The U.S. Americans with Disabilities Act (ADA) requires all businesses of a certain size or larger to have Text Telephone services available and to be able to receive calls from people using Text Telephones.

~~It is recommended~~ OEMs are encouraged to include Text Telephone capability for the type commonly used in the country of sale and use, such as Baudot in the United States, Minitel in France, and so on. In North America and Europe, the following types of Text Telephones are used:

?? Baudot: 45 or 50 bps Frequency-Shift-Keyed (FSK) and 5-bit Baudot coding

?? ASCII: 300 bps Bell 103 and 7-bit ASCII coding

?? European Deaf Telephone (EDT): 110 bps half-duplex V.21 and 7-bit coding

?? Minitel: V.23 modems and 7-bit coding

?? Modems and 7-bit coding

?? Dual-tone multifrequency (DTMF): 2-digit or 3-digit character coding

Consult ITU Recommendation V.18, which codifies how all these devices work and how to adaptively connect to all of them. ITU Recommendation V.250 contains these AT commands for control of V.18 features in a modem: +MV18S, +MV18R, +MV18AM, +MV18P.

ITU Recommendation V.18 codifies how all these devices work and how to adaptively connect to all of them. ITU Recommendation V.250 contains these AT commands for control of V.18 features in a modem: +MV18S, +MV18R, +MV18AM, +MV18P.

[19.11] If voice mode is implemented, voice modem supports ITU V.253 (AT+V)

This requirement includes support for +VTR (full-duplex voice).

TIA IS-101-1994, the interim standard for Voice DCE, has been superseded by TIA-695. TIA-695 adds voice formats and speakerphone control commands. ITU-T V.253 (formerly V.voice) was completed in January 1998 and is a superset of the TIA-695 U.S. standard. V.253 includes small corrections to TIA-695 and adds provisions for bi-directional, digitized voice over the serial port.

The following voice modem features are recommended:

?? Sense local telephone line state (on hook/off hook) without the modem going off hook

?? Extension (parallel) telephone answer and hang-up detection and reporting

?? Programmable gain control for all audio channels

?? Remote (far end) telephone answer and hang-up detection and reporting

?? Message waiting signal (stuttered dial tone) detection reporting

?? Special Information Tone (SIT) detection and reporting

?? Distinctive ring detection and reporting

?? Powered interface to the local telephone to support voice I/O and DTMF I/O

~~It is not required for~~ A voice modem can implement any recommended feature without being required to implement every feature in this list.

~~**[19.12] [DELETE] Voice modem supports +VTR command**~~

Note to Reviewers: Recommendations are not included in PC 2001

[19.13] If Called ID detection is implemented, modem supports Caller ID Reporting using +VCID and +VRID commands

Caller ID reporting is controlled with the AT+VCID and AT+VRID commands. As specified in V.253, Caller ID reporting is available in operating modes other than FCLASS 8 (Voice Mode). Therefore, ~~it is recommended that~~ the modem should support the AT+VCID and AT+VRID commands even if Voice Mode is not supported.

Note to Reviewers: With +VTR explicitly required, this requirement is no longer needed

[NEW] If voice mode is implemented in the modem, voice modem supports streaming audio

Note to Reviewers:Explanation to be provided in later draft.

[NEW] If voice mode is implemented in the modem, voice modem supports streaming audio

Note to Reviewers: Explanation to be provided in later draft.

~~**[19.14] [DELETED] Voice modem supports speakerphone**~~

Note to Reviewers: With +VTR explicitly required, this requirement is no longer needed

[19.23] Modem pair passes basic V.34 file transfer test

TIA standard TSB-38 specifies test procedures for evaluating modems. Test file **4.TST** contains random data and does not benefit from data compression.

This requirement is a basic test of modem functionality and verifies that the modem is able to connect at 31.2 Kbps, stay connected, and transfer data on a clean line for at least a half-hour, which is a typical time period for a modem session.

While operating in V.34 modulation on TIA TSB-37A line 18C2, the modems must be able to transfer 256 repetitions of the TSB-38 test file **4.TST** in 40 minutes or less, simultaneously in both directions, without hanging up or otherwise aborting the transfer. V.42 LAPM is enabled during this test. Data transmission runs directly on the modems without the use of an additional protocol such as Zmodem.

Impairment combination 18C2 in the TIA TSB-37A PSTN consists of very mild impairments. No V.34 modem should have difficulty operating on this line at least 31.2 Kbps.

Note: For modems certified for operation only in those countries outside of North America, impairment combination 2C4 as specified in ITU-T Recommendation V.56 *bis,* can be substituted for TSB-37A line 18C2. Recommendation V.56 *bis* is an international equivalent of TIA TSB-37A.

[19.24] Modem pair passes basic call connect reliability test

This requirement is a basic test of modem functionality and verifies that the modem can reliably connect a large number of times on good telephone channels.

While operating in V.34 modulation, the modems must be able to perform four repetitions of the Call Connect vs. Test Loop Combination test defined in TIA TSB-38 (476 total connection attempts), with an overall call completion success

ratio of 97 percent, and with neither modem stalling in an unresponsive, inoperable state.

As specified in TSB-38, the test channels 17C1 though 17C7 are used in this test because impairment combination 17C represents more than 55 percent of the combinations in the PSTN model defined in TSB-37A.

At the conclusion of each connection or connection attempt during the test, the modem port will be closed and then reopened for the next attempt.

Note: For modems certified for operation only in those countries outside of North America, the Call Connect Reliability Test specified in ITU-T Recommendation V.56 *ter*, can be substituted for that in TSB-38. Recommendation V.56 *ter*, an international equivalent of TIA TSB-38, specifies use of the PSTN model defined in Recommendation V.56 *bis.*

[19.25] Modem pair passes concurrency test

In this series of concurrency tests, the modem pair runs while a series of representative communications applications are running on the PC, for example, e-mail, web browsing, and H.263+ video teleconferencing.

[19.32] [REDUNDANT] Each hardware device has a unique Plug and Play device ID

[19.33] [REDUNDANT]Each device has a Plug and Play compatible ID

[19.34] [REDUNDANT] Dynamic resource configuration is supported for all devices

[19.35] [REDUNDANT] Modem meets PC 2001 requirements for PCI bus devices

Note to Reviewers: These basic PC 2001 requirements are no longer repeated in every chapter

[19.36] External USB modem supports USB specifications~~USB modem meets PC 2001 requirements for USB bus devices~~

A modem that uses USB must comply with all related USB specifications, including:

?? *USB Specification, Version 1.0~~0~~1* or later

?? *Universal Serial Bus Device Class Definition for Communication Devices, Version 1.0* or later

External modems may also support V.24 (RS-232) serial interfaces for legacy connectivity.

For compatibility with Unimodem and Windows USB serial drivers, a USB modem that incorporates the modem controller function must support the

mandatory and optional requests and notifications for Abstract Control Model Serial Emulation defined in section 3.5.1.2.1 of the *USB Class Definitions for Communication Devices Specification.*

[19.37] Device Bay modem meets PC 2001 requirements

A modem designed as a Device Bay peripheral must interface with ~~either~~ USB, IEEE 1394, or both buses. If implemented to use the USB bus, the device must support relevant USB device class specifications. All Device Bay peripherals must meet the requirements defined in *Device Bay Interface Specification, Version 1.0* or later.

[19.38] Modem complies with device class power management reference specification

~~Technical Clarification:~~ Support for power states D0 and D3 cold are required for PCI modems, including wake on ring.

The *Communications Device Class Power Management Reference Specification, Version 1.0* or later, provides definitions for the OnNow device power states (D0–D3) for modems. The specification also covers the device functionality expected in each power state and the possible wake-up event definitions for the class.

Power states D0 and D3 are required for modems on power-managed buses, including PCI, CardBus, and USB.

Modem adapters that use the PCI bus must be capable of generating a power management event (PME# assertion) from the D3 cold device state. ~~It is recommended that~~ Modem adapters also should support capture of Caller ID with hardware support for the AT+VRID “resend caller ID” voice modem command.

[19.39] Modem supports wake-up events

A modem must be able to cause a wake-up event on an incoming ring as defined in *Communications Device Class Power Management Reference Specification.* This requirement applies for modems on all power-managed buses, including PCI, CardBus, and USB.

The D2 power state is defined specifically for this purpose in the power management reference specification. The ability for a modem to cause a wake-up event from the D3 power state is also possible, and using the D3 state is recommend because it realizes better system power savings. To comply with this requirement, a modem must be able to cause a wake-up event from ~~either~~ the D2 state, the D3 state, or both states.

Because caller-ID reporting would be missed by PCs while in a sleep state, the modem should be able ~~the ability for a modem~~ to retain and repeat the last caller-ID reporting on demand~~is recommended~~. The mechanism for providing this capability ~~doing this~~ is described in *Communications Device Class Power*

Management Reference Specification and in the V.253 voice modem specifications.

PCI devices are required to support D3 cold on a PCI 2.2-based system with auxiliary power. On all other power-managed buses (such as USB), support for either D2 or D3 is acceptable.

[19.40] [REDUNDANT] Modem drivers meet PC 2001 requirements for device drivers and installation

Note to Reviewers: This basic PC 2001 requirement is no longer repeated in every chapter

[19.41] Modem driver supports Unimodem

The device driver must include Unimodem support. Typically, this requires a modem INF file, developed and verified using the MDK and pretested by the modem manufacturer.

[19.42] Applications provided with modem meet Win32 requirements

Any Windows-based applications provided with the device, such as fax utilities, must meet requirements for software compatibility as defined in the Microsoft Platform SDK.

Telephony applications and service providers ~~provid~~supplied with PC 2001 systems must be implemented using TAPI 2.0. Among other enhancements, applications can request, negotiate, and renegotiate QoS parameters with the network and receive indication of QoS on inbound calls and when QoS is changed by the network. For a summary of the TAPI 2.0 architecture and a description of how to write a TAPI service provider, see http://www.microsoft.com/win32dev/netwrk/tapiwp.htm. For implementation information, see the Microsoft Platform SDK.

Driver-based Modems

This section covers requirements for controller or “soft” modems, whereby the modem controller function, or both the modem controller and the modem datapump functions, are implemented on the Windows host~~CPU~~.

[NEW] If implemented as a riser card, the modem meets AMR Riser-card specification

If the modem hardware is implemented as a motherboard-connected riser card, it must comply with the AMR riser-card specification.

This requirement does not preclude the use of PCI- or motherboard-integrated modems.

Note to Reviewers: Specification details will be provided in a future draft.

[19.26] Driver-based modem uses a WDM-based driver solution

Note to Reviewers: These requirements will be redefined in a future draft.

Windows 98 and Windows 2000 share WDM kernel calls. Driver-based modems must use the WDM kernel so that both operating systems can use a common driver binary. For Windows 2000, these drivers must also support symmetric multiprocessors.

ISDN Modems

This section covers requirements for serial-port connected ISDN Terminal Adapters, commonly referred to as "ISDN modems."

[19.17] ISDN driver supports unattended installation, with limitations

In general, the driver must meet the PC 2001 requirements for drivers and installation, as defined in requirement [3.16], "Device driver and installation meet PC 2001 requirements." However, configuration of the dependent parameters, such as SPIDs and switch-type IDs, must be done using the ISDN Configuration Wizard included in the operating system.

[19.18] ISDN modem supports required command set

An ISDN modem must support the following:

?? Basic AT commands, such as TIA-602, which is a subset of ITU V.250

?? Commands to select the end-to-end protocol used over the ISDN, for example, synchronous PPP, V.110, V.120, and so on

?? Commands to set the switch type, subscriber numbers, or directory numbers

?? SPID or EAZ (where applicable) for user selection or if auto-detection fails, must be included, implemented in the device or in the communications driver

~~**[19.19] [DELETE] ISDN modem exposes both B-channels**~~

Note to Reviewers: Recommendations are not included in PC 2001

[19.20] ISDN modem supports asynchronous-to-synchronous conversion

These types of ISDN devices are treated as modems, not as internal ISDN devices supported using NDIS WAN miniports. In the external case, the primary implication is that the operating system will send byte-level PPP (also known as asynchronous PPP). In the NDIS WAN case, the implication is that the operating system will send bit-level PPP (also known as synchronous PPP).

Because ISDN is a synchronous service and an ISDN modem connects to an asynchronous port on the PC, the device must provide some means of converting asynchronous data to synchronous data.

~~**[19.21] [DELETE] ISDN modem defaults to HDLC PPP after INF installation**~~

Recommendations are not included in PC 2001

[19.22] ISDN modem uses high-speed port

Because of the speed limitations ~~inherent in a~~of PC~~'s~~ V.24 COM ports, the connection for external ISDN modems must ~~should~~ be by way of a high-speed bus such as USB 1.1 or IEEE 1394. ~~A specification for controlling an ISDN TA over USB is in development by the USB Communications Device Class working group.~~ ISDN BRI modems must implement:

?? *USB Specification, Version 1.1* or later

?? *Universal Serial Bus Device Class Definition for Communication Devices, Version 1.0* or later

ISDN PRI modems may use IEEE 1394.

Mobile Modems

This section covers the particular requirements of modems used in mobile systems. These are in addition to the Voiceband Modem guidelines identified in a previous section.

Note: The presence of a CardBus slot on the mobile PC meets the requirements for providing a communications device.

[19.15] If wireless support is implemented, Mobile PC modem supports +WS46 command

~~There are a variety of~~ Wireless modems and look-alike modems include the common types, such as North American analog cellular, cellular digital packet data (CDPD), global system for mobile communications (GSM), and other digital cellular systems, and several other types, such as the Ricochet modem from Metricom.

For all wireless and cellular modems, OEMs should use the commands in TIA-678~~are recommended.~~. The +WS-46 command, which selects the wide area network (WAN), is required.

Windows has registry keys that support analog cellular modems. Windows also supports data access in GSM and other wireless modem types. Participants in the Mobile Data Initiative are developing extensions for other services on digital cellular modems, as described in the following requirement.

[19.16] If digital cellular control is implemented, Mobile PC modem supports appropriate +C digital cellular standards

Digital cellular support is not a requirement, but if implemented, the following appropriate digital cellular control standards must be supported:

- TIA-678 +WS-46 selector command
- +CBC battery power monitoring command
- +CPAS phone activity status
- +CSQ signal quality monitoring command
- Class 2.0 facsimile services, per appropriate standard
- For GSM modems, +CBST protocol selection command

To allow software applications to specify settings and manipulate Short Messaging Service (SMS) through a GSM modem card, ~~it is recommended~~ the card should support the following GSM 07.05 commands.

- +CMGF: Message Format
- +CMGL: List Messages
- +CMGR: Read Messages
- +CMGS: Send Messages
- +CMGW: Write Messages
- +CNMI: New Message Indications to terminal equipment (TE)
- +CPMS: Preferred Message Storage
- +CRES: Restore Settings
- +CSAS: Save Settings
- +CSCA: Service Center Address
- +CSCS: TE character set selection
- +CSMS: Select Messaging Service

Unlike wireline data modems, these devices are not required to support V.34 signaling because none ~~it is not~~is available. Only 9600 bps capability is required~~; higher speeds are recommended where available.~~.

Class 1.0 fax support is available on some of these devices, but it is not required; the error rates with transparent modem faxes are often very high.

Cellular telephone systems are widely deployed in the industrialized world and are now being deployed internationally. In North America, analog cellular systems (TIA-553) are currently predominant, although two types of digital cellular systems can also be deployed: code division multiplexed access (CDMA; TIA IS-95) and time division multiplexed access (TDMA; IS-136).

In Europe and the rest of the world, the GSM digital cellular system is widely deployed. In Europe, the infrastructure for data, fax, and short messaging is now in place.

For all three digital cellular systems, the system design has been extended to offer data, fax, voice, and SMS to mobile users. In all cases, a modem pool is added to the ground stations, where connection is made to the Public Switched Telephone Network (PSTN). Access to the logical serial ports of these modems is made

using the digital error-controlled radio link to the equipped mobile phone and is exposed on a serial port or associated PC Card device.

Digital cellular communications equipment should default to using error correction on the radio link. For example, for GSM 7.07, the modem should initialize to +CBST=,,1 (which selects a “nontransparent” air interface).

To allow data cards to use GSM/ISDN V.110 “fast access” where available in the network, +CBST=71,, (9600 bps V.110) should be a valid setting.

The AT command sets for these digital cellular phone systems are contained in the following standards.

Standard	Command set
GSM 7.07	GSM system: data, fax, voice
GSM 7.05	GSM SMS
TIA IS-707	North American CDMA: data and fax
TIA IS-135	North American TDMA: data and fax

The TIA-678 +WS46 command has codes to indicate which system the modem is capable of. For example, the following values, quoted from Table 4 of the standard, are useful.

Value	System
1	Public telephone network (that is, a normal wireline modem)
4	CDPD
7	TIA-553 analog cellular system
10	Metricom Ricochet network
12	GSM digital cellular system
13	TIA IS-95 CDMA digital cellular
14	TIA IS-136 TDMA digital cellular (Personal Communications System [PCS])

Telephony

Note to Reviewers: Introductory text to be added.

[NEW] If telephony applications are implemented in the system, a common set of audio I/O devices is used for system audio and telephony applications

If the system enables telephony applications such as speakerphone, IP telephone, and so on, for each type of audio I/O device, the same device must be usable for both system audio and telephony. For example, the same set of speakers shall be

usable for both system audio and speakerphone functions, or, when using a headset, users need not change plug locations when switching from listening to CD-audio to speaking on the phone.

[NEW] If telephony applications are implemented in the system, telephony implementations follow industry telephony performance guidelines

If the system enables telephony applications such as speakerphone or IP telephone, it must comply with telecomm industry guidelines for such parameters as send and receive loudness, echo, and so forth.

For speakerphone applications, the guidelines in ITU-T Recommendation P.340, *Transmission characteristics of hands-free telephones*, are applicable. Otherwise, ITU-T Recommendation P.310, *Transmission characteristics for telephone band (300-3400 Hz) digital telephones*, is applicable. U.S. Committee T1 Technical Report No. 56, *Performance guidelines for voiceband services over hybrid internet/PSTN connections*, provides useful guidance for IP telephony functions.

Checklist for Communication Devices

[20.1] [REDUNDANT] PC system includes network adapter

[20.7] Network adapter uses NDIS 5.0 miniport driver

[20.8] Intermediate NDIS 5.0 miniport driver is deserialized

[20.9] Full-duplex adapter automatically detects and switches to full duplex mode

[20.10] Adapter automatically senses presence of functional network connection

[20.11] Adapter automatically senses transceiver type

[20.12] Adapter can transmit packets from buffers aligned on any boundary

[20.13] Adapter communicates with driver across any bridge

[20.14] Adapter supports filtering for at least 32 multicast addresses

[20.15] Adapter and driver support promiscuous mode

[20.16] Adapter is compatible with remote new system setup capabilities if used as a boot device

[20.17] PCI network adapters are bus masters

[20.18] Device Bay-type network adapter meets PC 2001 requirements

[20.19] If Implemented, USB or IEEE 1394 device meets specifications for network communications devices

[20.20] Network adapter and driver supports priority for IEEE 802-style networks

[20.21] Internal ISDN device meets PC 2001 network adapter requirements

[20.22] Internal ISDN device supports synchronous HDLC framing

[20.23] NDIS interface and driver support raw unframed synchronous B channel I/O

[20.24] ISDN driver supports unattended installation, with limitations

[20.26] ISDN device includes software-selectable terminating resistors

[20.28] Integrated cable modem meets PC 2001 network adapter requirements

[20.29] Integrated cable modem exposes an ATM or Ethernet interface

[20.30] ATM adapter meets PC 2001 network adapter requirements

[20.31] ATM adapter supports a minimum number of simultaneous connections

[20.33] ATM adapter supports UBR service type

[20.34] ATM adapter supports a minimum number of simultaneously active VBR or CBR connections

[20.35] ATM adapter supports traffic shaping

[20.36] ATM adapter enforces PCR on UBR virtual circuits

[20.37] ATM adapter and driver support dynamic link speed configuration

[20.38] ATM adapter that supports OAM responds to F4 and F5 loopback cells

[20.41] Integrated ADSL modem meets PC 2001 network adapter requirements

[20.43] UADSL modem supports DMT line encoding

[20.45] Infrared device meets PC 2001 network adapter requirements

[20.46] Infrared device supports both FIR and SIR

[20.47] IrDA hardware supports unattended driver installation

[20.48] If implemented, home networking adapter meets PC 2001 network adapter requirements

[20.50] Home networking media supports IP

[NEW] If implemented, system that supports Home RF complies with SWAP specification

[NEW] If implemented, system that supports Bluetooth complies with Bluetooth 1.0

[20.51] [REDUNDANT] Each device has a unique Plug and Play device ID

[20.52] [REDUNDANT] Dynamic resource configuration is supported for all devices

[20.53] Plug and Play capabilities support multiple adapters

[20.54] All resource settings are reported in the user interface

[20.55] Adapter complies with Network Device Class Power Management Reference Specification

[20.56] Network device supports wake-up events

[20.57] [REDUNDANT] Device drivers and installation meet PC 2001 requirements

[20.58] Driver works correctly with Microsoft network clients and protocols

[20.59] NDIS miniport driver makes only NDIS library calls or WDM system calls

[20.60] NDIS 5.0 driver uses Windows 2000 INF format

[19.3] Modem supports V.250 AT command set

[19.4] Modem supports V.90 (1998) analog modem modulation

[19.5] If V.34 SRC is implemented, modem supports Annex A/V.34 (1998) Seamless Rate Change (SRC)

[19.6] Modem must support V.42 LAPM, V.42 bis, and V. 80 Synchronous Access data protocols

[19.7] Modem supports call control signaling, controlled using V.251 modem commands

[19.8] FAX modem supports 14.4 Kbps (V.17) with Class 1 command set

[19.9] If delayed and blacklisted number tables are implemented, modem clears its tables when off hook

[19.10] If TDD support is implemented, modem supports TDD, meeting V.18-1996 with V.250 AT commands

[19.11] If voice mode is implemented, voice modem supports ITU V.253 (AT+V)

[19.13] If Called ID detection is implemented, modem supports Caller ID Reporting using +VCID and +VRID commands

[NEW] If voice mode is implemented in the modem, voice modem supports streaming audio

[NEW] If voice mode is implemented in the modem, voice modem supports streaming audio

[19.23] Modem pair passes basic V.34 file transfer test

[19.24] Modem pair passes basic call connect reliability test

[19.25] Modem pair passes concurrency test

[19.32] [REDUNDANT] Each hardware device has a unique Plug and Play device ID

[19.33] [REDUNDANT]Each device has a Plug and Play compatible ID

[19.34] [REDUNDANT] Dynamic resource configuration is supported for all devices

[19.35] [REDUNDANT] Modem meets PC 2001 requirements for PCI bus devices

[19.36] External USB modem supports USB specifications

[19.37] Device Bay modem meets PC 2001 requirements

[19.38] Modem complies with device class power management reference specification

[19.39] Modem supports wake-up events

[19.40] [REDUNDANT] Modem drivers meet PC 2001 requirements for device drivers and installation

[19.41] Modem driver supports Unimodem

[19.42] Applications provided with modem meet Win32 requirements

[NEW] If implemented as a riser card, the modem meets AMR Riser-card specification

[19.26] Driver-based modem uses a WDM-based driver solution

[19.17] ISDN driver supports unattended installation, with limitations

[19.18] ISDN modem supports required command set

[19.20] ISDN modem supports asynchronous-to-synchronous conversion

[19.22] ISDN modem uses high-speed port

[19.15] If wireless support is implemented, Mobile PC modem supports +WS46 command

[19.16] If digital cellular control is implemented, Mobile PC modem supports appropriate +C digital cellular standards

[NEW] If telephony applications are implemented in the system, a common set of audio I/O devices is used for system audio and telephony applications

[NEW] If telephony applications are implemented in the system, telephony implementations follow industry telephony performance guidelines